NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

THESIS

A METHODOLOGY FOR EVALUATING FORCE PROTECTION DURING A COMPUTER AIDED EXERCISE

by

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September 1996

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1996	Master's Thesis

4. TITLE AND SUBTITLE A METHODOLOGY FOR EVALUATING FORCE PROTECTION DURING A COMPUTER AIDED EXERCISE	5. FUNDING NUMBERS
6. AUTHOR(S) Thurman, John L.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution is unlimited.	

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14. SUBJECT TERMS After Action Review, UJTL, JTLS			15. NUMBER OF PAGES 55
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

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A METHODOLOGY FOR EVALUATING FORCE PROTECTION DURING A COMPUTER AIDED EXERCISE

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
September 1996

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ABSTRACT

The development of a proficient staff at the Joint Level is primarily accomplished through the use of computer aided exercises (CAXs). The primary purpose of these exercises is to increase the readiness of the staff to perform actual missions from standing up a Joint Task Force (JTF) to redeployment of the forces. A measure of the tasks required of a staff is accomplished through a Mission Essential Task List from the Universal Joint Task List (UJTL). This document defines critical events and activities that must be accomplished to achieve the desired mission goals. The measurement of that performance from actual data from the computer model has been limited. This thesis provides a methodology that assists in the evaluation of force protection. This quantitative analysis can be provided quickly and concurrent to the exercise. Immediate feedback helps the staff and commander to understand why an outcome happened through linkage of UJTL tasks. This methodology was tested using the Joint Theater Level Simulation and the results demonstrating the methodology and analysis of the output are presented.

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EXECUTIVE SUMMARY

Training is the basic tool that a commander has to raise the proficiency of his or her unit to prepare for its military mission. Training must be realistic and tough. At lower levels of command, the primary method of training is the field training exercise (FTX). For higher levels of command, FTXs are unrealistic in terms of money, amount of subordinate troops required and land use. Beginning in the late 1980s, the Department of Defense began investing heavily in incorporating computer models into large exercises such as Return of Forces to Germany (REFORGER). This allowed the joint staffs to get better training from the exercises because they could give orders, make plans and have constructive feedback from a model without having actual troops on maneuvers.

This thesis develops a methodology for measuring the level of force protection during a computer aided exercise. This methodology is demonstrated within the context of a simulation using the Joint Theater Level Simulation. Measurement of a staff's capability to perform mission essential tasks is critical for two reasons. The first is to ensure that while training is being conducted, training resources are being used wisely and that training objectives are being realized. The second reason is to assure that staff proficiency is adequately measured to determine what tasks need further training. At the current time the capability does not exist to quickly and concurrently analyze the performance of a staff during a CAX.

The Joint Chiefs of Staff (JCS) Memorandum of Policy 26 (MOP 26) lays out the responsibilities of a joint training requirement for the JCS, Joint Commanders-in-Chief (CINCs), and the CINC's component staffs. In support of this, the JCS have developed the Universal Joint Task List to provide the CINCs a methodology to construct a CINC's Joint Mission Essential Task List (JMETL). The UJTL, as developed by Dynamics Research Corporation (DRC) under the direction of the Joint Exercise and Training Division of the J7, JCS, supports the Joint Training Manual (MCM 71-92). The UJTL outlines in common language those essential tasks that a commander could possibly have to carry out. They cover the entire spectrum of military operations at the strategic (national and theater level), operational and tactical levels of war. At each level of war the

tasks are broken down into supporting tasks, enabling tasks and further enabling tasks. A commander then selects from the whole UJTL through an analysis of command guidance and his mission based on his forces, their equipment and his area of responsibility. These selected tasks combine to form his JMETL. The command assessment of the level of training on those tasks then provides a tool to guide training.

Joint tasks describe the capabilities of our Armed Forces. They are assigned by joint force commanders to be carried out by integrated Service components. Each task then results in a condition and standard for performance; or in other words, a required capability. Force protection is a required capability, and this thesis provides a better insight on how that capability is being applied.

To measure force protection, this thesis uses firepower scores and force ratios to evaluate force protection. Firepower scores can give the relative indications about the strength of a unit, its combat effectiveness, and what it is capable of doing. By examining the strength of a unit, when it was engaged or threatened to be engaged, and then the firepower score over time, a decision maker is better able to understand why a unit may or may not be able to function on a specified mission. Given that force protection is a combat multiplier, leaders can better understand how their force protection plans bear on the battle. This methodology has been demonstrated using the Joint Theater Level Simulation (JTLS).

The strengths of the methodology are that it is uncomplicated, easy to produce and can be quickly understood by the training audience. Simple file manipulation and the graphical output can all be done through commercial spreadsheet packages. By understanding the implications of force protection during and immediately after an exercise provides a better training experience and enhances the readiness of a decision maker and his or her staff.

I. INTRODUCTION

Training is the basic tool that a commander has to raise the proficiency of his or her unit to prepare for its military mission. Training must be realistic and tough. At lower levels of command, the primary method of training is the field training exercise (FTX). For higher levels of command, FTXs are unrealistic in terms of money, amount of subordinate troops required and land use. Beginning in the late 1980s, the Department of Defense began investing heavily in incorporating computer models into large exercises such as Return of Forces to Germany (REFORGER). This allowed the joint staffs to get better training from the exercises because they could give orders, make plans and have constructive feedback from a model without having actual troops on maneuvers.

A. BACKGROUND

The evolution of these types of exercises has resulted in a command post exercise that is supported by a computer model, or Computer Aided Exercise (CAX). Current simulations within the joint arena are the Joint Theater Level Simulation (JTLS), the Joint Aggregate Level Simulation Protocol Joint Training Confederation (ALSP-JTC) and the Joint Conflict Model (JCM). Under current development is the Joint Simulations System (JSIMS) which will expand the range of training to include operations other than war added to the traditional combat roles.

These exercises involve gathering a large number of individuals that support a training audience. The soldiers, sailors, airmen, and Marines that provide the individual players in the simulation come from many different organizations. In most CAXs, the players are brought together shortly before the exercise for quick training; they execute the plan and then quickly disperse. There is often very little time for an after action review that involves substantive quantitative data from the simulation. Also, there are few indicators for a commander to determine whether the training is accomplishing its stated goals while the training is occurring. Immediate feedback both during and after an exercise would be of great benefit for all involved with the exercise.

B. PROBLEM STATEMENT

This thesis develops a methodology for measuring the level of force protection during a computer aided exercise. This methodology is demonstrated within the context of a simulation using the Joint Theater Level Simulation. Measurement of a staff's capability to perform mission essential tasks is critical for two reasons. The first is to ensure that while training is being conducted, training resources are being used wisely and that training objectives are being realized. The second reason is to assure that staff proficiency is adequately measured to determine what tasks need further training. At the current time the capability does not exist to quickly and concurrently analyze the performance of a staff during a CAX. This thesis augments previous research efforts by US Army Captain Ray Combs and US Navy Lieutenant Chris Towery on different areas of the Universal Joint Task List. It is part of an ongoing project, with methodologies for different tasks being developed by other Naval Postgraduate School students. These theses are listed in Appendix A.

C. THESIS STRUCTURE

Chapter II provides an overview of Force Protection and the Universal Joint Task List. Chapter III discusses descriptive performance measures and the methodology for developing those measures. Chapter IV presents the application of the methodology to the Joint Theater Level Simulation (JTLS) and results from a post exercise analysis. Chapter V provides the conclusions and recommendations for future research.

II. OVERVIEW OF FORCE PROTECTION

Force protection is one of the most basic and intuitive responsibilities of command. It is something for which every commander from the company to theater command has an intimate and immediate concern. By ensuring adherence to the principles of force protection, a commander makes his or her force as combat effective as possible.

Force protection is defined by the Department of Defense Dictionary of Military and Associated Terms as

> (A) security program designed to protect soldiers, civilian employees, family members, facilities, and equipment, in all locations and situations, accomplished through planned and integrated application of combating terrorism, physical security, operations security, personal protective services, and supported by intelligence, counterintelligence, and other security programs (151).

This chapter describes the basic tenants of force protection and its applicability to the Universal Joint Task List (UJTL).

A. UNIVERSAL JOINT TASK LIST (UJTL)

The Joint Chiefs of Staff (JCS) Memorandum of Policy 26 (MOP 26) lays out the responsibilities of a joint training requirement for the JCS, Joint Commanders-in-Chief (CINCs), and the CINC's component staffs. In support of this, the JCS have developed the Universal Joint Task List to provide the CINCs a methodology to construct a CINC's Joint Mission Essential Task List (JMETL). The JMETL allows a CINC to focus training on those fundamental tasks that are required for mission success in his or her area of responsibility. It also allows the commander to "institutionalize a requirements-based, 'train-to-task' joint training system" (UJTL, 1-1).

The UJTL, as developed by Dynamics Research Corporation (DRC) under the direction of the Joint Exercise and Training Division of the J7, JCS, supports the Joint Training Manual (MCM 71-92). The UJTL outlines in common language those essential tasks that a commander could possibly have to carry out. They cover the entire spectrum of military operations at the strategic (national and theater level), operational and tactical levels of war. At each level of war the tasks are broken down into supporting tasks,

enabling tasks and further enabling tasks. A commander then selects from the whole UJTL through an analysis of command guidance and his mission based on his forces, their equipment and his area of responsibility. These selected tasks combine to form his JMETL. The command assessment of the level of training on those tasks then provides a tool to guide training.

Joint tasks describe the capabilities of our Armed Forces. They are assigned by joint force commanders to be carried out by integrated Service components. Each task then results in a condition and standard for performance; or in other words, a required capability. They do not tell a commander how to accomplish that task (UJTL, 1-1).

The Chairman of the Joint Chiefs of Staff (CJCS) has specifically laid out in his annual guidance that commanders are responsible for training and that commanders assess training. The development of a JMETL through the UJTL allows the commanders to accomplish that guidance. "Developing a training program or scheduling an exercise without a JMETL linkage may result in unfocused and often wasteful expenditure of scarce resources, and should be viewed as lower priority" (CJCSI 3500.02, A-6). This statement alone clearly and succinctly shows the importance of developing relevant JMETLs and a methodology for training with them.

B. JOINT THEATER LEVEL SIMULATION (JTLS)

JTLS is an aggregated model that is a man-in-the-loop, multi-sided, joint (air, land, sea, SOF) and combined constructive simulation model. This model simulates conflict at the operational level of war with tactical fidelity. It can be utilized for both the planning of contingency operations and in training support of Computer Aided Exercises (CAXs). JTLS closely models modern coalition warfare through dynamic coalition development, designation of political or military factions, setting Rules of Engagement, executing Host-Nation Support agreements and conducting Noncombatant Evacuation Operations. The most recent version of JTLS can be run on an open system for distribution across multiple hardware platforms and has a graphical user interface (GUI). JTLS was initially developed by Rolands and Associates of Monterey, California in 1982, and is still maintained by them today.

C. DEFINITION OF FORCE PROTECTION

Force protection is the combination of all the things that a commander can do to conserve the fighting potential of a force. Force protection involves all actions that reduce the probability and minimize the effects of enemy action on personnel, equipment and critical facilities. It provides for the health, welfare, morale and maintenance of the force. Protection ensures the safety of personnel and includes those measures that prevent fratricide. (JP 3-0, IV-9).

Force protection involves careful and methodical planning that reduces or eliminates risks. Commanders at all levels must conscientiously consider for all phases which approach will result in better force protection. This can be done through passive defensive measures such as careful placement of units and operations security measures (OPSEC). These are low cost measures that can have a large payoff towards protecting the force. In addition, a commander can enhance the protection of the force through hardening of critical assets, providing additional defensive units whose mission it is to protect specific assets, providing special equipment that augments the defensive posture such as early warning devices and layering the defense through air defense units, close air support or units in a screening or guarding mission.

The amount of force protection a commander provides to a force is a difficult decision. Assets that are given a force protection role usually could have been used in offensive operations. Determining the correct mix between defensive posturing that allows a force to maintain its operational tempo and those forces dedicated to offensive operations is complex. A commander must analyze the enemy threat and his own vulnerabilities. Is the operational tempo allowing the commander to operate and execute inside the enemy's decision cycle? If so, that itself is a force protection measure. If the enemy is being successful in his operations against friendly forces, the command is then more vulnerable and must increase its force protection measures. In any given situation a commander has a continuous responsibility to evaluate the force protection requirements. An increased threat forces a commander to increase his force protection to reduce his risk.

D. DEFINITION OF CRITICAL ASSETS

Critical assets are any supplies, pieces of equipment or units with unique capabilities that if lost or damaged, will cause the force to fail in its mission. They are usually specifically identified in a commander's order. Examples of critical assets are jet or helicopter fuel, command and control equipment, special munitions, Stinger missiles, refugee collection points, ammunition supply points, communication nodes, aircraft carriers, satellites, VIPs, airfields and aircraft hangers. Another way to view critical assets is that they are mission essential elements of an operation.

E. DEFENSIVE MEASURES

As previously discussed, there are active and passive measures that a commander can take to protect his force. This section covers some of the basic measures available to a commander. Traditionally the biggest threats to a force have been the following:

1. The employment of weapons of mass destruction (WMD) that include nuclear, biological and chemical (NBC) weapons.
2. A threat from the air directed from fixed wing aircraft, helicopters, ballistic missiles, very short range ballistic missiles, cruise missiles, unmanned aerial vehicles (UAVs) or low-observables.
3. A threat to the sustainment base and lines of communication from unconventional forces, special operations forces or enemy units .

As the Armed Forces modernize, additional threats will come from electronic interference, OPSEC being compromised through the media and the development of the non-linear battlefield, coupled with dispersion causing fratricide and wider maneuver area for enemy forces (Protect the Force, 2).

The centerpiece of force protection is warning. The intelligence system provides to commanders an assessment of the current enemy situation that allows him to make a decision on the force protection requirements. If the threat from special forces is nonexistent, the defensive posture in the rear areas of the battlefield will appear very different than if the threat is high. Assessment of the capability will drive the allocation of protection assets. This process takes place from pre-deployment through redeployment.

It has broad-reaching effects from the flow of forces to the arrayment of units on the battlefield.

Another force protection measure is reducing enemy targeting effectiveness. This ranges from physical camouflage that protects over a multi-spectral range to electronic camouflage through high technology information operations. By not allowing the enemy to see the force, he cannot interrupt the operational tempo.

The most conventional methods of force protection are reducing the effectiveness of enemy action. This is accomplished through many different systems and units. The air defense systems that cover an area of operation include the families of High-to-Medium Altitude Air Defense (HIMAD), Theater High-altitude Area Defense System (THAAD) and Short Range Area Air Defense (SHORAAD). Security forces that include infantry, armor, attack helicopter or military police units provide additional layers of defense for critical assets. Large ammunition supply points (ASPs), for example, are often protected by an infantry unit that is enhanced by a military police unit on patrol near, along with an on-call tactical combat force (TCF) that can respond to level III threats. More recent developments in digitized communications also reduce the effectiveness of enemy action by denying him information about friendly operations. Counterbattery fires, smart missiles and smart artillery submunitions all force the enemy to slow through destruction of equipment and forces or to redirect his movement and fire. Effectiveness can also be reduced through pre-deployment immunizations that prevent or reduce biological and chemical attack effects.

The enhancement of personnel, equipment and critical facility survivability allows friendly assets to survive despite an enemy attack. Examples of this are equipment and facilities that are hardened or equipped with anti-ballistics, units that are placed in optimal geographic locations and soldiers that are given bullet and shrapnel proof clothing. It is this type of force protection that reduces the probability of kill of an enemy system.

F. THESIS APPLICATION

This thesis considers specific areas of force protection. Methodology is presented to determine how effectively additional ground forces are being used to protect critical assets on the battlefield. The protection addressed is in terms of organic unit defense,

additional ground forces on a specific protection mission, attack helicopters that are on-call to those critical assets or to the additional ground forces, friendly field artillery within range and AC-130 gunships. It also considers the coverage of air defense umbrellas at all three levels of protection.

III. METHODOLOGY - DESCRIPTIVE MEASURES DEVELOPMENT

This chapter relates in detail how the descriptive quantitative measures for force protection were developed. This methodology closely follows the work that was done in CPT Ray A. Comb's NPS thesis dealing with logistics. The basis for this methodology is the task linkage of the UJTL. Tasks can be linked vertically or horizontally. Vertical linkage connects tasks across the different levels of war and is along functional lines. Horizontal linkage, or end-to-end linkage, involves those different tasks that must be performed in close coordination with each other to achieve mission success.

The steps that are followed in this methodology are the development of a joint task schematic, the relationship of issues to the performance data requirements or dendritic and finally, resolving the required descriptive measures.

A. JOINT TASK SCHEMATIC

The issue of force protection covers all three levels of war and has horizontal linkage to other tasks. Figure 1 shows these linkages for the two areas covered in this thesis. Across the figure in purple are the different levels of war and the tasks covered. Down the figure are the supporting and enabling tasks with Protect Forces and Means in green and Aerospace and Missile Defense in blue. The vertical linkage to TA 5 is shown in yellow. The colors show the vertical linkage of the tasks. The tasks at the bottom are the functionally horizontal linkages. This chart does not attempt to show all possible horizontal linkages within the area of force protection. Single digit numbers at each level are joint tasks, two digit numbers are supporting tasks, three digit numbers are enabling tasks and four digit numbers are further enabling tasks. The UJTL indexes are defined in Appendix B.

Important to note in this task schematic are the relationships among tasks within a functional area. Moving left to right depicts the hierarchical relationships of the tasks among the different levels of war.

This schematic was developed by searching through the UJTL with the JoinT-CAT software to identify those different tasks that are related to force protection.

Each task was evaluated based on its description and chosen based on its doctrinal relationship to force protection.

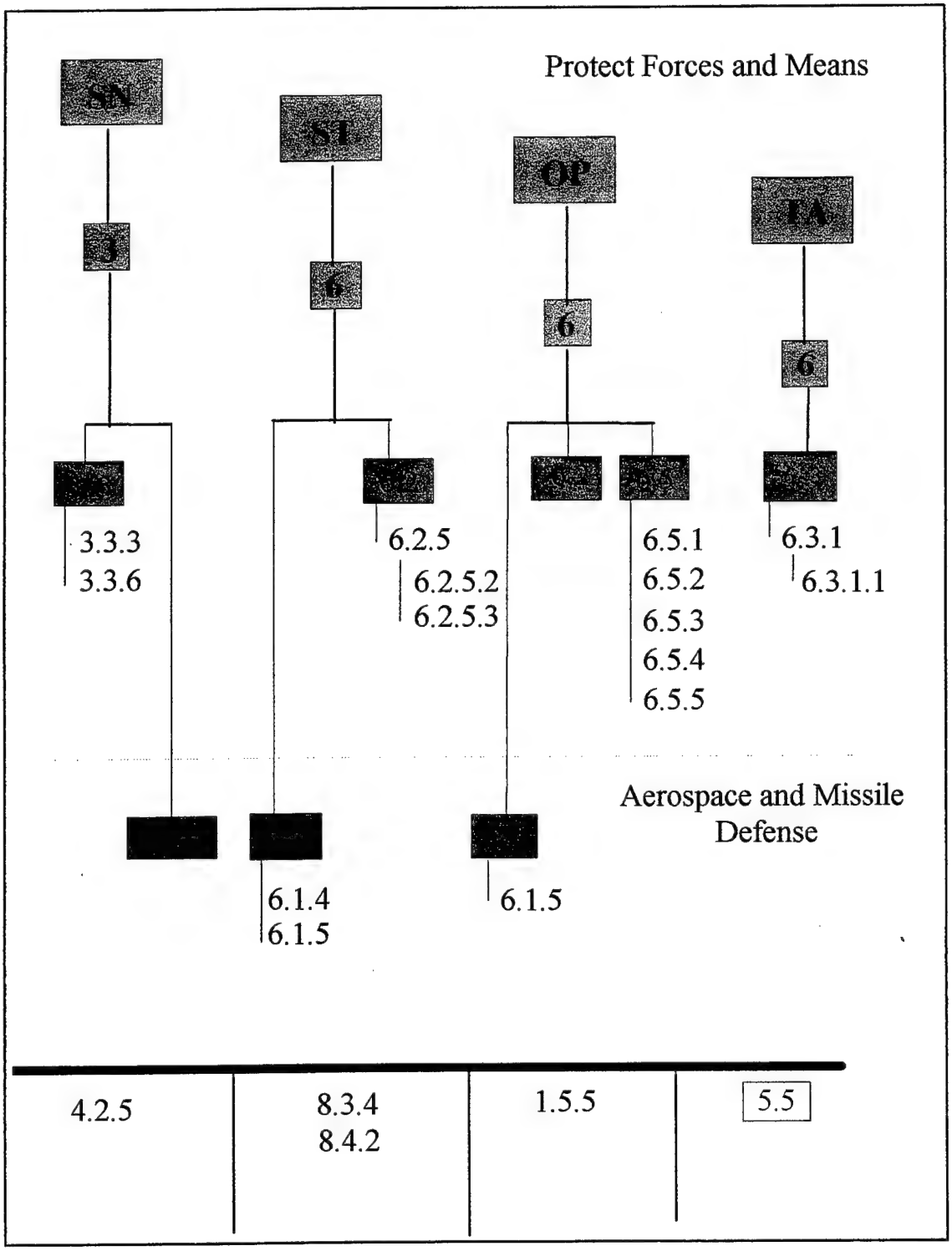

Figure 1. Task Schematic

B. DENDRITIC

The dendritic is a tool that allows an issue to be defined in terms of data requirements. It starts in the form of a question that branches out into issues and sub-issues, and finally enables specific data requirements to be defined. The data can be objective or subjective. Objective data provide for measurements while subjective data help to define non-measurable factors. These data requirements then allow an analyst to go into a model and extract the required data. The two dendritics in Figures 3 and 4 are both derived from the issue, critical issues and sub issues stated in Figure 2. Figure 3 deals with air defense protection and Figure 4 deals with additional force protection measures.

Issue: How well are the forces protected?

Critical Issues:

1. How well are the forces protected from the enemy's firepower and maneuver?
2. How well is the health, welfare, morale, and maintenance of the force being provided?
3. How well is the safety of the forces being provided?
4. How well is fratricide of the force being prevented?

Sub Issues:

1. Are critical assets under the protection of an air defense umbrella?
2. Are critical assets given an adequate level of ground protection?
3. Are critical assets within an adequate response time of the tactical combat force (TCF)?
4. Can the operational commander afford this level of protection?

Figure 2. Dendritic for developing data requirements

Sub Issue #1

Are critical assets under the protection of an air defense umbrella?

Measures of Performance

1. What level of ADA protection can the critical assets provide itself?
2. What do additional levels of ADA protection add to the critical asset's protection?
3. How much ADA protection does the critical asset have at any given time?
4. What are the requirements for ADA protection of the critical asset?

Data Requirements

1. Time.
2. Location of friendly ADA units by type (THAAD, HIMAD, SHORAAD).
3. Times that ADA units are providing coverage.
4. Time hostile aircraft and missiles are intercepted.

Figure 3. Dendritic development for ADA protection

Sub Issue #2

Are critical assets given an adequate level of ground protection?

Measures of Performance

1. What level of protection can the critical asset provide itself?
2. What do additional levels of protection add to the critical asset's protection?
3. How much protection does the critical asset have at any given time?
4. What are the requirements for protection of the critical asset?

Data Requirements

1. Time.
2. Operating capability of a critical asset.
3. Operating capability of enemy forces within striking distance.
4. Number of hits by type on a critical asset.

Figure 4. Dendretic development for ground protection

C. DESCRIPTIVE MEASURES

To measure force protection, this thesis will use firepower scores and force ratios as described in Aggregated Combat Modeling by Hartman, Parry, and Caldwell. Firepower scores are calculated by summing the combat power values for each system in the unit. The resultant score is called a Firepower Index (FPI), calculated as follows:

$$FPI = \sum_{i=1}^{n} X_i * S_i \qquad (1)$$

where

X_i is the number of weapons of type i in the unit for i=1, 2, 3...n

S_i is the score value representing combat power for each type i weapon

A ratio then can be used to compare attacking units to defending units in battle. This force ratio gives a measure of relative combat power in the battle and is defined as:

$$FR = \frac{FPI_{Attacker}}{FPI_{Defender}} \qquad (2)$$

Firepower scores do have limitations that any user must be aware of when used in aggregate attrition modeling. The most serious limitation is that the score is both linear and additive. There is no marginal benefit or diminishing return for additional weapon systems and no minimum requirement is established for battle. Because of the lack of interaction between combat systems, no synergistic effects are represented. Finally, there is no agreement on what firepower score values should be used. Because of this subjectivity, the results of any analysis can be the source of wariness or doubt.

Given these shortfalls, however, firepower scores can give relative indications about the strength of a unit, its combat effectiveness, and what it is capable of doing. Another method of determining the firepower score value is to consider the capabilities of the system and its value based on what it is capable of attriting. The score for a weapon is then defined to be proportional to the total value for all the enemy systems it kills. This is the basis of the Eigenvalue or Anti-Potential Potential (APP) Method.

JTLS does not use APP, but the firepower score values are based on the observation of what a weapon could accomplish in a battle. JTLS uses one set of scores for each unit, stored in a file called the Tactical Unit Prototype (TUP). JTLS uses 84 different TUP files. Any unit used in a simulation must be modeled as belonging to a

TUP. JTLS uses FPIs for the calculation of a portion of unit strength. All attrition is done by Lanchesterian attrition modeling.

D. SPREADSHEET ANALYSIS

To gather the data required for an after-action review, Rolands and Associates has developed a set of files that can be used for postprocessing. These files contain the various data requirements in ASCII format that have been generated in conjunction with the UJTL assessment effort. They vary from engagement results, air tracking, logistical supplies, strength, location, and a variety of other critical information. There are checkpoints that are taken periodically during a simulation at which time the postprocessing files are updated. Any time a change in status occurs, it is recorded in the appropriate file.

The actual files used are the strength, location, air detection, combat systems and logistical files. The contents in each file are described in the JTLS player's manual. The files were reduced in size by either editing them through a program written for this thesis with Borland® Turbo Pascal® for Windows™ version 1.5, Thinner, or by spreadsheet manipulation in Lotus® 1-2-3® Release 5 for Windows™. For direct spreadsheet use, the file is first imported using the ASCII filter and combined into the current worksheet. The data are sorted and then cut to another spreadsheet for analysis. Depending on the length of the checkpoint, commercial spreadsheets may not be able to import the post-processing files directly, thus requiring the use of Thinner. Thinner requests the name or names of the desired units and outputs an ASCII file with all the data from the post-processing file applicable to the units of interest. The checkpoints during the simulation are taken every twelve hours, and for the most part can be directly imported into the spreadsheet. The computer code for Thinner is given in Appendix C.

Thinner or sorting on each unit by time gives the spreadsheet the data from each postprocessing file in chronological order. Three graphs were made for each critical asset from the data. Unit strength is graphed as a percentage of combat systems and logistical stockage on-hand over those required over time. The Firepower Score Graph is calculated by multiplying the firepower index according to the TUP for that unit by the number of systems on-hand and then summing over the combat systems.

E. SUMMARY

This thesis tracks those critical assets and units, examines their firepower scores graphically, and compares them to any actual or potential threats. Viewed in light of a force protection plan and the amount of risk a commander is willing to take, the commander and staff is provided a picture of how well critical assets are being protected, their effect on the main effort and how their protection or loss affects the outcome of the battle. This dynamic score presented over time is the key to understanding the battle in terms of critical asset protection and *why* that asset had an influence on the outcome of the battle. By establishing where critical events are linked, a commander has a better

IV. EXPERIMENTAL SIMULATIONS

A. JTLS APPLICATION

The Joint Theater Level Simulation uses SIMSCRIPT to support the need for a discrete event simulation. The advantage of a discrete event simulation is the ability to model activities that have been identified as critical events. The key processes of a theater level, air-land battle are most easily visualized as a collection of discrete events. Some of these events can be identified as critical to the outcome of a battle. They occur at a specific time and have the potential for changing the state of the systems. This characteristic of the model then allows the gathering of the appropriate data for the assessment of force protection.

Units are modeled as entities within the simulation. As previously discussed, each unit is modeled using a Tactical Unit Prototype (TUP). The TUP identifies the equipment, capabilities and supplies on-hand, given that a unit is at 100 percent strength. The unit can be ordered into various tactical postures and assigned missions. The unit automatically assumes certain postures such as defend or withdraw if pre-established thresholds in the TUP are reached.

Given that force protection is not a combat mission unto itself, it is not something that a unit can be ordered to do in JTLS. Instead, it is up to the player to properly decide unit placement, posture, special operating forces alert status and other force protection enhancements. In a given plan, force protection can be assessed at specific times using the status of a unit based on its strength, combat systems on-hand and supplies on-hand. The application of force protection principles, or the lack thereof, directly affects the levels of these measures. Depending on the criticality of a given unit, the loss of operating capability or supply can be linked directly or indirectly to a critical event in the battle. The tracking of these measures aids in validating the methodology of linking UJTL tasks to critical events and in doing so, gives the commander a better idea of not only what happened in a battle, but *why*. Analysis of these measures provides new insights into the impact of force protection on the force.

B. SCENARIO DESCRIPTION

Four runs of the JTLS simulation were made to generate data for demonstration of the methodology. There were two basic scenarios used for the four simulation runs. All were set in the Southwest Asia theater of operations. The first scenario, named Heavy, was similar to Desert Storm in that Iraq had invaded Kuwait and had operationally paused in a defensive posture on both sides of the Saudi Arabian boarder. This scenario was developed to demonstrate the difficulty in generating combat power and establishing a tactical advantage. Iraq had displaced all Kuwaiti combat forces and was in control of the theater. Their objective was to seize the Trans-Arab pipeline and control the flow of oil in northern Saudi Arabia.

The second scenario, named Light, had a build-up of forces along the Iraq-Kuwait boarder threatening Kuwait. US forces were flowing into Kuwait to prevent an attack. In both scenarios, two branches (sets) were created where one (set 1) allowed unimpeded flow of equipment and units into theater and in the other (set 2) of the same scenario, an aerial attack on blue port operations hampered the flow. In all runs, the principles of force protection remained the same. The primary difference was the operational availability of additional force protection assets such as air defense artillery determined by when they arrived in theater.

C. ANALYSIS OF FORCE PROTECTION

On the first day of the heavy scenario, the forces were arrayed as shown in Figure 5. At the 3.01 decimal day point, a Red air attack was successful in launching long range missiles against targets at the VII (US) Corps Main Headquarters. In this case, even though the unit had adequate ground and air protection, the air defense was unable to prevent the attack due to the stand-off capabilities of the rockets. The unit's strength over time is shown in Figure 6.

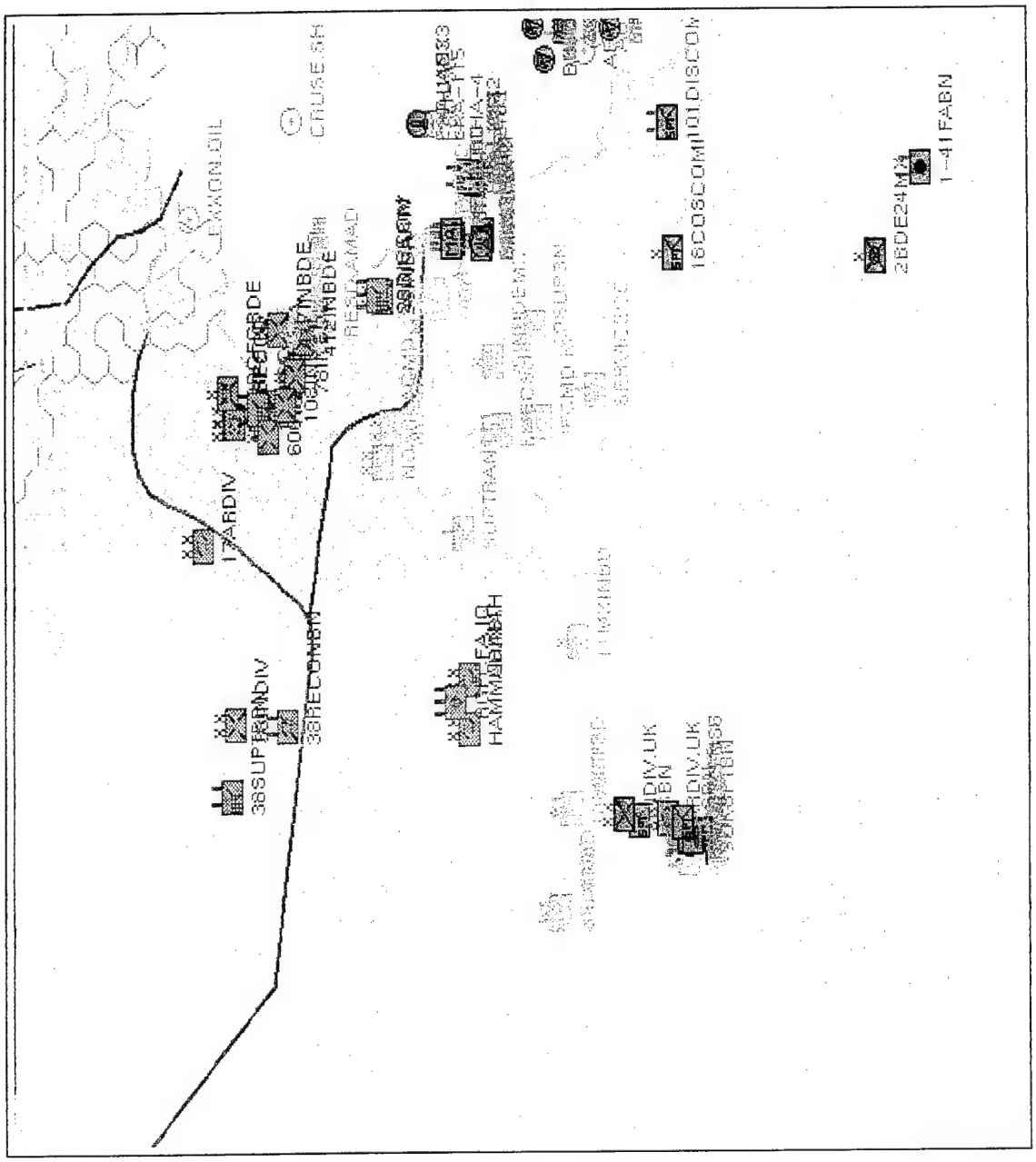

Figure 5 Heavy Initial Tactical Layout

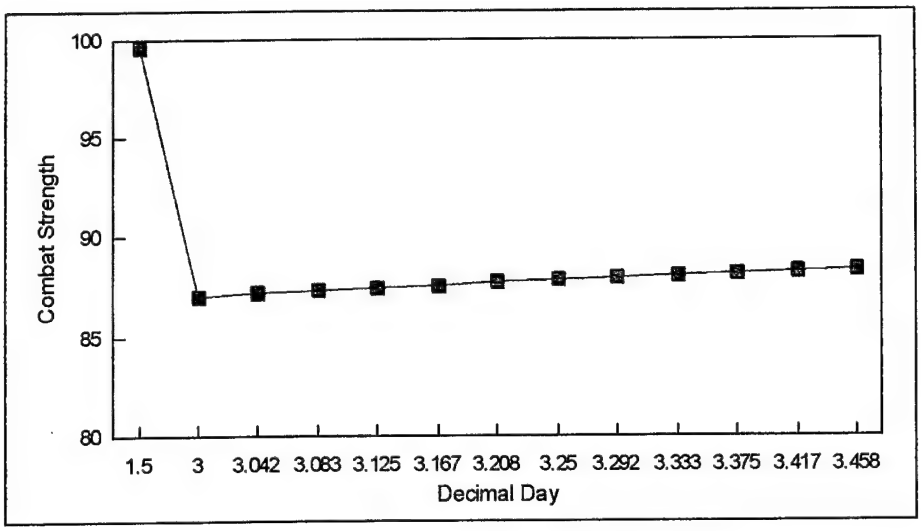

Figure 6 VII Corps Combat Strength

When the unit was attacked, its combat strength immediately dropped, but its combat effectiveness is masked since strength percentages also include the logistical supplies. In this attack, only combat systems were hit. The graph in Figure 7 shows the individual systems that make up the total firepower score. One of the unit's most important assets, C3I, suffered a 75% loss. In this case the unit definitely would require immediate re-supply of communications equipment and would have to pass its combat mission to either the Corps Rear or Corps Tactical Headquarters.

By examining the firepower score, the decision maker is better able to understand why a unit may or may not be able to function on a specified mission. Had the damage from the rocket attack affected the trucks and small arms, the unit would be able to continue its primary mission of command and control without being impeded. The main force protection issue illustrated here is the lack of adequate THAAD coverage. The inability to protect against long range missile attacks caused a significant interruption in the headquarter's decision cycle and operation. Another force protection issue illustrated by this example is that the unit remained in the same location for three days. With its proximity to the enemy force, and the US not having the initial tactical advantage, the headquarters probably should have been moved at least once during the operation immediately following the attack.

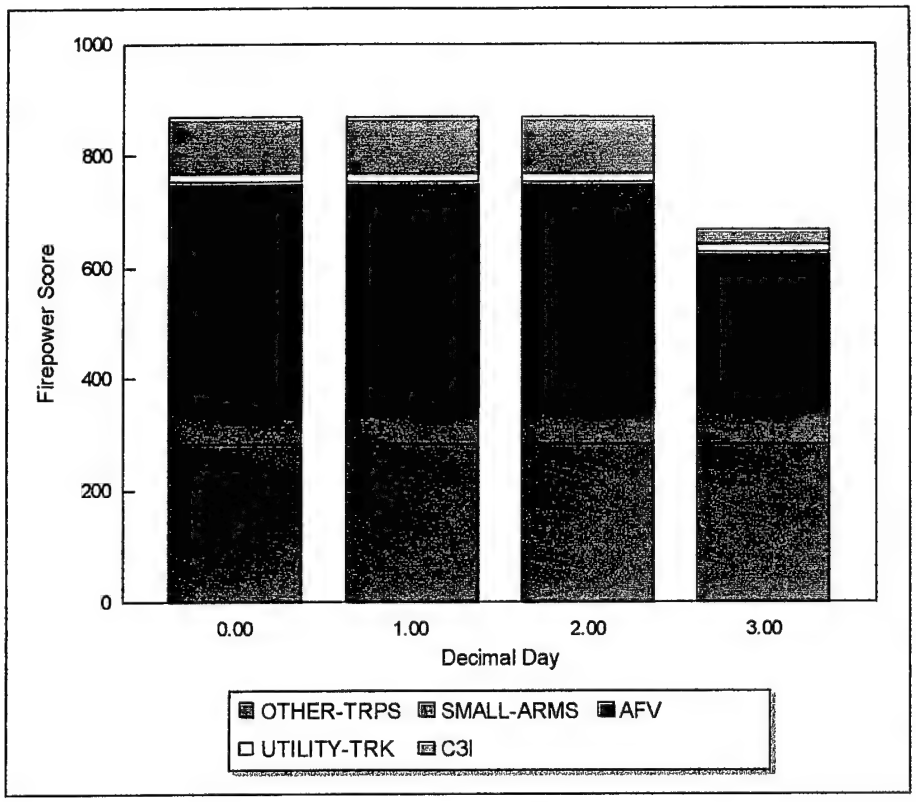

Figure 7 VII Corps Firepower Scores

In another example of using firepower scores to evaluate the effectiveness of force protection, the 1st Direct Support Battalion (UK) came under aerial rocket attack at decimal day 0.96. Their unit strength and firepower scores are shown in Figures 8 and 9, respectively. With minimal losses on combat systems, they were able to continue their mission in support of the 1st Armor Division (UK). This support included movement up to the boarder of Iraq and Kuwait to assist in the expulsion of the Iraqi forces. The unit was able to provide direct support to its parent unit and did not come under further hostile fire, even though the unit was within 20 kilometers of enemy forces. Through proper land management, tactical location and defensive posture on the move, the unit enhanced its force protection.

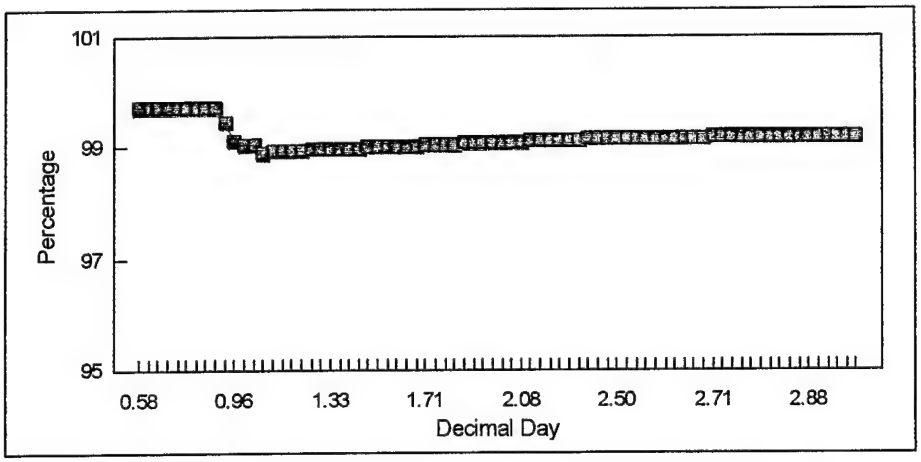

Figure 8 1st DS Bn Combat Strength

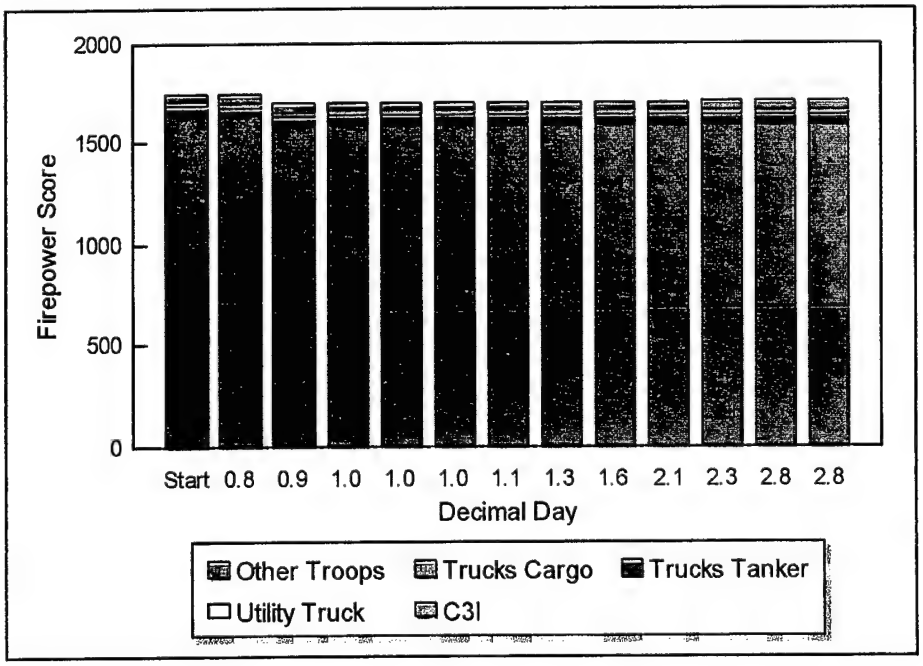

Figure 9 1st DS Bn Firepower Scores

The final example of this methodology shows a unit's strength over time where force protection was adequate. The 24th Marine Service and Supply Group (MSSG24) during the light scenario was in support of the 24th Marine Expeditionary Unit (MEU) in Kuwait. At decimal days 0.83 and 1.24, there were attempts by the Iraqi Air Force to attack the MSSG24 with MIG attack aircraft. The unit was correctly located in relation to the 24th MEU and was under the umbrella of Army air defense at all levels (HIMAD, THAAD, AND SHORAAD). It was fully supplied and its strength was 100 percent for the entire exercise because it was not interdicted by an attack nor its effectiveness reduced because of combat losses. If there was any problem with the unit's performance, it did not occur due to a lack of combat power or force protection. The unit's combat strength and combat power graphs are shown in Figures 10 and 11, respectively.

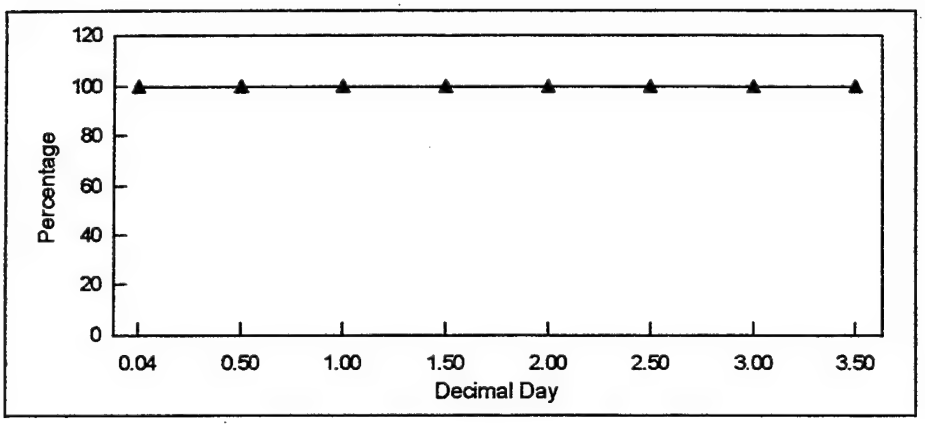

Figure 10 MSSG24 Combat Strength

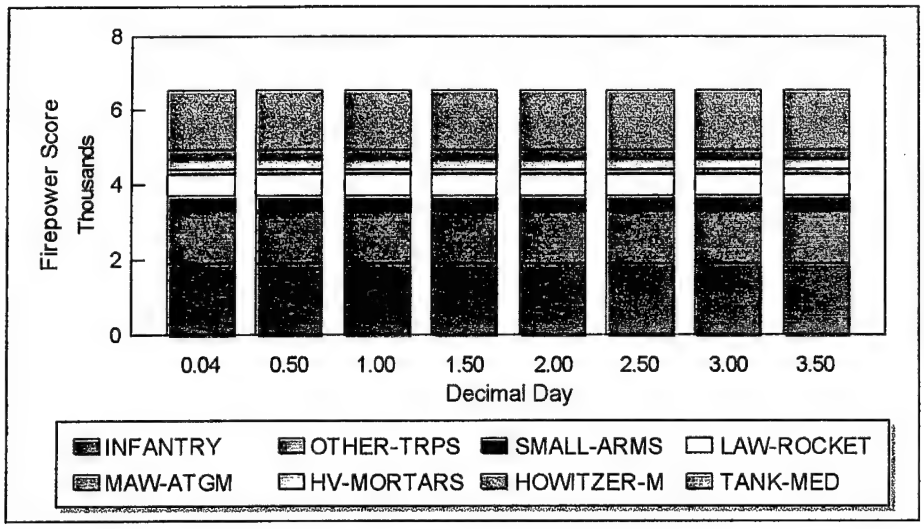

Figure 11 MSSG24 Firepower Scores

D. CONCLUSION

Force protection is a combat multiplier. By being able to see where weaknesses exist and how they affect specific combat systems, leaders can better understand how their force protection plans bear on the battle. This UJTL task is linked to all the others in that the lack of critical assets can force maneuver units to be less effective or unable to create the momentum necessary to gain the advantage to win the battle.

The next chapter discusses the conclusions of evaluating force protection and provides recommendations for further development for the use of this product in the context of an after action review.

V. SUMMARY AND RECOMMENDATIONS

A. SUMMARY

This thesis presents a methodology for evaluating the performance of force protection functions during a computer aided exercise as they pertain to selected universal joint tasks. It is not an attempt to assign value to a plan or the execution of one, but rather presents a means of identifying critical events and provides insights to their causal reasons during an exercise. By analyzing the components of what makes an event critical, the training audience can realize the importance of an element of a mission plan. Examining the unit's strength and its Total Firepower Score provides quantitative descriptors of the unit's capabilities. Knowledge of what force protection measures were in place or being used then indicates the impact of a unit on the battle's outcome.

The strengths of the methodology are that it is uncomplicated, easy to produce and can be quickly understood by the training audience. Simple file manipulation and the graphical output can all be done through commercial spreadsheet packages. Although the model has only been tested in JTLS, it uses data that are readily available and easy to obtain from most event step simulation models.

This method of task evaluation is only one portion of the analysis as to why a mission succeeded or failed. The reader is highly encouraged to review the previous work done by Combs and Towery on this topic, as well as the concurrent work being published by five other NPS students. A complete listing of these theses is contained in Appendix A.

B. RECOMMENDATIONS

The next level that the after-action products from these research efforts need to move to is an integrated package. An after action review team should be able to take the post-processing files from the simulation, select which graphical outputs they want, and have them produced with little user action required. A graphical user interface (GUI) that presents the different UJTL tasks and what after action review products are available would allow causal reasons for critical events to be shown across several functional areas.

At present, to create the product described in this thesis, an analyst must gather the required simulation files, sort them, trim the excess data, and then manually create the graph in a spreadsheet application. Automation of this function would dramatically decrease the amount of time required to produce the product, freeing the after action review team to examine more units and events in greater detail.

Another recommendation is that these methodologies be utilized in another simulation other than JTLS. JTLS currently does not have the fidelity to implement with precision all the force protection measures a unit could utilize. In a simulation that allows different levels of defense, patrols, or rewards the use of terrain, a better picture of the adequacy of the force protection plan could be seen.

Further development of this methodology could be tailored to meet individual requirements established by a participating command. To conduct this development, however, precise user requirements must be specified. The after action review products from all of these theses need to be introduced to enhance upcoming exercises. By involving the training audience that will ultimately be the beneficiary of these tools, the products can be further refined to produce a complete package encompassing all the work done to this point on UJTL linkage.

APPENDIX A - LIST OF CONCURRENT THESES

Brown, Kevin P. *Evaluating Operational Maneuver in a Computer Exercise*. Master's Thesis, Operations Research Department, Naval Postgraduate School, Monterey, CA 1996.

Cwick, Mark. *Analyzing Amphibious Logistics Capabilities in the Joint Theater Level Simulation (JTLS).* Master's Thesis, Operations Research Department, Naval Postgraduate School, Monterey, CA 1996.

Gordon, Kerry. *A Methodology for Evaluating the Performance of Operational Firepower during a Computer Aided Exercise* Master's Thesis, Operations Research Department, Naval Postgraduate School, Monterey, CA 1996.

Mustin, John B. *Evaluating Carrier Battlegroup Anti-Air Warfare Capability in a Computer Aided Exercise* Master's Thesis, Operations Research Department, Naval Postgraduate School, Monterey, CA 1996.

Sullivan, Mark. *A Methodology for Evaluating A Joint Mobilization Plan Using the Joint Theater Level Simulation (JTLS)* Master's Thesis, Operations Research Department, Naval Postgraduate School, Monterey, CA 1996.

APPENDIX B - UJTL INDEX DEFINITIONS

The following UJTL indexes are identified from Figure 1:

Strategic National Level of War

Task Index	Definition
3	Employ Forces
3.3	Protect Strategic Forces and Measures
3.3.3	Coordinate Worldwide Operations Security
3.3.6	Provide Security for Strategic Forces and Means
3.4.6	Provide Space Control
4.2.5	Provide Defensewide Base Operations Support

Strategic Theater Level of War

Task Index	Definition
6	Provide Theater Protection
6.1	Provide Theater Aerospace and Missile Defense
6.1.4	Provide for Theater Air Defense
6.1.5	Provide Theater Missile Defense
6.2	Provide Protection for Theater Strategic Forces and Means
6.2.5	Provide Security for Theater Forces and Means
6.2.5.2	Secure and Protect Theater Installations, Facilities, and Systems
6.2.5.3	Secure and Protect Theater Air, Land, and Sea LOCs
8.3.4	Obtain Multinational Support against Nonmilitary Threats
8.4.2	Assist in Combating Terrorism

Operational Level of War

Task Index	Definition
6	Provide Operational Protection
6.1	Provide Operational Aerospace and Missile Defense
6.1.5	Conduct Operational Area Missile Defense
6.2	Provide Protection for Operational Forces, Means, and Noncombatants
6.5	Provide Security for Operational Forces and Means
6.5.1	Provide Counterreconnaissance in Theater of Operations/JOA
6.5.2	Protect and Secure Flanks, Rear Areas, and COMMZ in Theater of Operations/JOA
6.5.3	Protect/Secure Operationally Critical Installations, Facilities, and Systems
6.5.4	Protect and Secure Air, Land, and Sea LOCs in Theater of Operations/JOA
6.5.5	Integrate Host-Nations Security Forces and Means
1.5.5	Assist Host-Nation in Populace and Resource Control

Tactical Level of War

Task Index	Definition
6	Provide Mobility and Survivability
6.3	Enhance Survivability
6.3.1	Protect against Combat Area Hazards
6.3.1.1	Protect Individuals and Systems
5.5	Employ Tactical C2W

APPENDIX C - PASCAL PROGRAM

The following program is the Turbo Pascal program code for the program Thinner. The program contains its own documentation. This program can be easily adapted to reduce the size of any JTLS post-processing file. The program requests the name of the unit or units that are desired and the type of file. It then outputs an ASCII file that can be imported into a spreadsheet.

```
Program Thinner;

{This program will take specific UJTL files listed below and remove
undesired data from the file and return the "thinned" file}

{Written by CPT John L. Thurman, USA, Naval Postgraduate School,
Monterey, CA 17 MAY 96
In support of Master's thesis work with Pr. Sam Parry on the UJTL
Project.}

uses WinCrt;

const MaxArraySize=40;

var JTLSFile, ThinnedFile:text;
    InfileName, OutfileName:string [25];
    NumberOfUnits,i,TypeOfFile:integer;


Procedure Thin1;{thins CBTSYS files}

 var time:string[10];
    UnitName:string [13];
    g1,g2,g3:string[2];
    cbtsys:string [14];
    amount:string[8];
    k:integer;
    NamesOfUnits1 : Array [1..MaxArraySize] of string [13];

begin
 for i:=1 to NumberOfUnits do
  begin
    writeln('What is the name of the number ',i,' unit to remain?');
```

```
    writeln('Ensure you have 13 characters and spaces EXACTLY as in the file.');
    readln(NamesOfUnits1[i]);
   end;
  while (not SeekEOF(JTLSFile)) do
   begin
    read(JTLSFile,time,g1,UnitName,g2,cbtsys,g3,amount);
    for k:=1 to NumberOfUnits do
     begin
      if NamesOfUnits1[k] = UnitName then
       begin
        writeln(ThinnedFile, time, UnitName,cbtsys,amount);
       end; {if}
     end; {for}
   end; {while}
end; {procedure}


Procedure Thin2;  {Thins LOCATE files}

var Time:string[10];
   g1:string[5];
   indicator1:string[3];
   UnitName:string[26];
   NamesOfUnits2 : Array [1..MaxArraySize] of string [26];
   Lat,Long:string[12];
   g2,indicator2:string[2];
   g3,g4:string[1];
   k,i:integer;

begin
 for i:=1 to NumberOfUnits do
  begin
   writeln('What is the name of the number ',i,' unit to remain?');
   writeln('Ensure you have 26 characters and spaces EXACTLY as in the file.');
   readln(NamesOfUnits2[i]);
  end;
 while (not SeekEOF(JTLSFile)) do
  begin
   read(JTLSFile,time,g1,Indicator1,UnitName,g2,Lat,g3,Long,g4,indicator2);
   for k:=1 to NumberOfUnits do
    begin
     if NamesOfUnits2[k] = UnitName then
      begin
       writeln(ThinnedFile, time,Indicator1,UnitName,Lat,Long,indicator2);
      end; {if}
```

```
      end; {for}
    end; {while}
end; {procedure}


begin
 writeln('What is the name of the input file?  Include the drive.');
 readln(InfileName);
 writeln('What is the name of the output file?  Include the drive.');
 readln(OutfileName);
 assign (JTLSFile,InfileName);
 assign (ThinnedFile,OutfileName);
 rewrite(ThinnedFile);
 reset(JTLSFile);
 writeln('How many units will remain?');
 readln(NumberOfUnits);
 writeln('Enter what type of file is to be thinned');
 writeln('1 = CBTSYS');
 writeln('2 = LOCATE');
 readln(TypeOfFile);
 if TypeOfFile = 1 then
  begin
   Thin1;
  end;
 if TypeOfFile = 2 then
  begin
   Thin2;
  end;
 close(ThinnedFile);
END.
```

APPENDIX D - JTLS SAMPLE FILES

The following are samples cut from the post-processing output files from JTLS:

Strength

Decimal Day		Unit	Strength
1.5	1	1-227AVBN	99.93
1.5	1	1-AVBN101	99.93
1.5	1	1ARBDE1AR	99.63
1.5	1	1ARBDE1AR	305.71
1.5	1	1ENBDE	99.36
1.5	1	1-9FABN	99.62
1.54	1	10SUPBN	99.77
1.54	1	1ARDIV.UK	97.89
1.54	1	10MXINBD	99.18
1.54	1	1DSBN	99.01

Combat Systems

Decimal Day	Unit	Combat System	Amount
2	1DSBN	TRUCKS-TANKE	9
2	1DSBN	TRUCKS-CARGO	182
2.13	1DSBN	TRUCKS-CARGO	182
2.13	1DSBN	TRUCKS-TANKE	9
2.17	1DSBN	UTILITY-TRK	23
2.33	1DSBN	C3I	2
2.42	1DSBN	C3I	2
2.33	1DSBN	OTHER-TROOPS	714
2.04	1DSBN	TRUCKS-CARGO	182
2.08	1DSBN	OTHER-TROOPS	713
2.04	1DSBN	C3I	2
2.08	1DSBN	TRUCKS-TANKE	9
2.08	1DSBN	TRUCKS-CARGO	182
2.38	1DSBN	UTILITY-TRK	23

Posture

2	1	1-11FABN	DEFEND	DEFEND
2	1	1-11FABN	INACTIVE	DEFEND
2	1	11FABDE18	DEFEND	DEFEND
2	1	11FABDE18	INACTIVE	DEFEND
1.5	1	1-227AVBN	DEFEND	DEFEND
1.5	1	1-227AVBN	INACTIVE	DEFEND
2	1	1-229ATKH	DEFEND	DEFEND
2	1	1-229ATKH	INACTIVE	DEFEND

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JoinT-CAT, version 2.1, Dynamics Research Corporation, Army Research Lab, Human Research and Engineering Division, Aberdeen Proving Ground, MD 1 June 1995.

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